Appendixes

Evaluating CBO's Record of Economic Forecasts

Since issuing its first forecast in 1976, the Congressional Budget Office (CBO) has compiled a record for accurate economic predictions that compares favorably with the track records of five Administrations, as well as with consensus forecasts of a sizable sample of private-sector economic forecasters. Although the margin is slight, CBO's forecasts have generally been closer than the Administration's to the actual values of several economic indicators that are important for projecting the budget. Moreover, during the 11 years for which comparisons are possible, CBO's forecasts have been about as accurate as the average of the 50 or so forecasts that make up the *Blue Chip* consensus survey. Comparing CBO's forecasts with that survey suggests that when CBO's economic predictions missed the mark by a wide enough margin to contribute to sizable misestimates of the deficit, those errors probably reflected limitations that confronted all forecasters.

These conclusions echo the findings of previous studies published by the Congressional Budget Office and other government and academic reviewers. They emerge from an evaluation of the accuracy of short-term forecasts for four economic indicators: growth in real output, inflation in the consumer price index (CPI), interest rates on three-month Treasury bills in both nominal and inflation-adjusted (real) terms, and interest rates on 10-year Treasury notes and Aaa corporate bonds. In carrying out the evaluation, CBO compiled two-year averages of its f · ?casts for the four indicators and compared them with historical values, as well as with the corresponding forecasts of the Administration and the *Blue Chip* consensus.

Both CBO and the Administration have tended to err toward optimism in their forecasts for a two-year horizon. In other words, the average forecast error for real growth was an overestimate, and the average error for inflation was an underestimate. The Administration has also been more optimistic than CBO in forecasting interest rates, with the average error being an underestimate. Overall, the average errors in the Administration's two-year forecasts were slightly larger than in CBO's. Moreover, an examination of longer-term projections of growth in real output reaches similar conclusions: CBO's errors in projecting four-year average growth in real output were optimistic on average but smaller than the Administration's. For the longer-term projections, both CBO and the Administration recorded larger errors on average than was the case for their short-term forecasts. Finally, CBO's forecasts appear to be about as accurate as the *Blue Chip* consensus over the period for which comparable *Blue Chip* forecasts are available (1982-1992).

The differences among the three forecasts, however, are not large enough to be statistically significant. The small number of forecasts available for the analysis makes it difficult to distinguish meaningful differences in forecast performance from differences that might arise randomly. Thus, the statistics presented here are not reliable indicators of the future performance of any of the forecasters.

Sources of Data for the Evaluation

Evaluating CBO's forecasting record requires compiling the basic historical and forecast data for growth in real output, CPI inflation, and interest rates. Although each of these series has an important influence on budget projections, an accurate forecast of the two-year average growth in real output is the most critical economic factor in accurately estimating the deficit for the upcoming budget year. Two-year average forecasts published in early 1993 and 1994 could not be included in the evaluation because historical values for 1994 and 1995 are, of course, not yet available.[1] The data were therefore compiled using forecasts published early in the years 1976 through 1992.

Selection of Historical Data

Which historical data to use for the evaluation was dictated by the availability of actual data and the nature of the individual forecasts examined. Although CBO, the Administration, and *Blue Chip* all published the same measure for real output growth, selecting a historical series was difficult because of periodic benchmark revisions to the actual data.[2] By comparison, not all of the forecasters published the same measures for CPI inflation and interest rates, but the selection of historical data for these series was clear-cut.

Real Output Growth. Historical two-year averages of growth in real output were developed from calendar year averages of the quarterly benchmark-years-weighted indices of real gross national product (GNP) and real gross domestic product (GDP) published by the Bureau of Economic Analysis (BEA).

The fact that several real GNP and GDP series were discontinued because of periodic benchmark revisions meant that they were unsuitable historical series.

For example, during the 1976-1985 period, the three forecasters published estimates for a measure of growth in real GNP that was based on 1972 prices, the measure published by BEA at the time. In late 1985, however, BEA discontinued this 1972-dollar series and began to publish GNP on a 1982-dollar basis. As a result, an official series of values for GNP growth in 1972 dollars is not available for years after 1984; thus, actual two-year average growth rates are not available to compare with the forecasts made in early 1984 and 1985. From 1986 to 1991, forecasters published estimates of growth in real GNP based on 1982 prices. BEA revised the benchmark again in the second half of 1991; it discontinued the 1982-dollar GNP and began to publish GNP on a 1987-dollar basis.[3] Consequently, the historical annual series for 1982-dollar GNP is available only through 1990, and actual two-year average growth rates are not available for the forecasts made in early 1990 and 1991.

By periodically updating the series to reflect more recent prices, BEA's benchmark revisions yield a measure of real output that is more relevant for analyzing contemporary movements in real growth. But the process makes it difficult to evaluate forecasts of real growth produced over a period of years for series that are subsequently discontinued. Recently, however, the difficulties presented by periodic revisions of the data have been diminished by the availability of new benchmark-years-weighted indices of real GNP and GDP. In 1992, BEA began regularly to publish and update these alternative series for real growth.[4]

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1. The Clinton Administration adopted CBO's economic assumptions as the basis for its budget in early 1993. As a result, once the 1994 data are available, the errors for the early 1993 forecast will be virtually the same for CBO and the Administration.

2. Before 1992, CBO, the Office of Management and Budget, and *Blue Chip* used gross national product to measure output. However, beginning in early 1992, all three forecasters began to publish forecasts and projections of gross domestic product instead.

3. With the 1992 benchmark revision, GDP replaced GNP as the central measure of national output.

4. For details of the conceptual basis and empirical characteristics of this new series, see A.H. Young, "Alternative Measures of Change in Real Output and Prices," *Survey of Current Business* (April 1992), pp. 32-48; J.E. Triplett, "Economic Theory and BEA's Alternative Quantity and Price Indexes," *Survey of Current Business* (April 1992), pp. 49-52; and A.H. Young, "Alternative Measures of Change in Real Output and Prices: Quarterly Estimates for 1959-92," *Survey of Current Business* (March 1993), pp. 31-41.

CPI Inflation. Two-year averages of inflation in the consumer price index were calculated from calendar year averages of monthly data published by the Bureau of Labor Statistics. Before 1978, the bureau published only one consumer price index series, known today as the CPI-W (the price index for urban wage earners and clerical workers). In January 1978, however, it began to publish a second, broader consumer price index series, the CPI-U (the price index for all urban consumers). CBO's comparison of forecasts used both series.

Until 1992, the Administration published its forecasts for the CPI-W, the measure used to index most of the federal government's expenditures for entitlement programs. By contrast, for all but four of its forecasts since 1979 (1986 through 1989), CBO based its inflation forecast on the CPI-U, a more widely cited measure of inflation and the one now used to index federal income tax brackets. The *Blue Chip* consensus has always published its forecast of the CPI-U. Although both the CPI-U and CPI-W may be forecast with the same relative ease, and annual fluctuations in the two series are virtually indistinguishable, they do differ in some years; for that reason CBO used historical data for both series to evaluate the alternative forecast records.

Interest Rates. Two-year averages of nominal short- and long-term interest rates were developed from calendar year averages of monthly data published by the Board of Governors of the Federal Reserve System.

The forecasts of short-term interest rates were compared using historical values for two measures of the interest rate on three-month Treasury bills: the new-issue rate and the secondary-market rate. The new-issue rate forecast by the Administration corresponds to the price of three-month bills auctioned by the Treasury Department--that is, it reflects the interest actually paid on that debt. The secondary-market rate forecast by CBO, by contrast, corresponds to the price of the three-month bills traded outside the Treasury auctions. Because these transactions occur continually in markets that involve many more traders than do Treasury auctions, the secondary-market rate provides an updated evaluation by the wider financial community of the short-term federal debt. *Blue Chip* has alternated

between these two rates: publishing the new-issue rate from 1982 to 1985, switching to the secondary-market rate for the 1986-1991 period, and then returning to the new-issue rate in 1992. Clearly, there is no reason to expect the two rates to differ persistently; indeed, the differences between their calendar year averages are minuscule.

The various forecasts of long-term interest rates were likewise compared using historical values for two measures of long-term rates: the 10-year Treasury note rate and Moody's Aaa corporate bond rate. A comparison of forecasts is only possible beginning in 1984 because not all of the forecasters published projections of long-term interest rates before that year. For forecasts made in early 1984 and 1985, CBO projected the Aaa corporate bond rate. Beginning with its early 1986 forecast, however, CBO switched to the 10-year Treasury note rate. The Administration has always published its projection for the 10-year Treasury note rate, but *Blue Chip* has published the Aaa corporate bond rate.

Separate historical values for real short-term interest rates were calculated using the nominal short-term interest rate and inflation rate appropriate for each forecaster. In each case, the two-year average nominal interest rate was discounted by the two-year average rate of inflation. The resulting real short-term interest rates were very similar. Since there is no agreed-upon method for calculating real long-term interest rates, they were not included in the evaluation.

Sources of Forecast Data

The evaluation used calendar year forecasts and projections, which CBO has published early each year since 1976, timed to coincide with the publication of the Administration's budget proposals. The Administration's forecasts were taken from the Administration's budget in all but one case: the forecast made in early 1981 came from the Reagan Administration's revisions to President Carter's last budget. The corresponding CBO forecast was taken from a projection published in its analysis of the Reagan budget proposals. That forecast did not

include the economic effects of the new Administration's fiscal policy proposals.

The average forecasts of the *Blue Chip* consensus survey were taken from those published in the same month as CBO's forecasts. Because the *Blue Chip* consensus did not begin publishing its two-year forecasts until the middle of 1981, the first consensus forecast available for use in this comparison was published in early 1982.

Measuring Bias and Accuracy

Following earlier studies of economic forecasts, this evaluation of CBO's forecasts focused on two aspects of forecast performance: statistical bias and accuracy.

Bias

The statistical bias of a forecast is the extent to which the forecast can be expected to differ from what actually occurs. CBO's evaluation used the *mean error* to measure statistical bias. That statistic--the arithmetic average of all the forecast errors--is the simplest and most widely used measure of forecast bias. Because the mean error is a simple average, however, underestimates and overestimates offset each other in calculating it. As a result, the mean error imperfectly measures the quality of a forecast--a small mean error would result either if all the errors were small or if all the errors were large but the overestimates and underestimates happened to balance out.

Accuracy

The accuracy of a forecast is the degree to which forecast values are narrowly dispersed around actual outcomes. Measures of accuracy more clearly reflect the usual meaning of forecast performance than does the mean error. This evaluation used two measures of accuracy. The *mean absolute error*--the average of the forecast errors without regard to arithmetic sign--indicates the average distance between forecasts and actual values without regard to

whether individual forecasts are overestimates or underestimates. The *root mean square error*--calculated by first squaring all the errors, then taking the square root of the arithmetic average of the squared errors--also shows the size of the error without regard to sign, but it gives greater weight to larger errors.

Measurement Issues

These three statistics do not exhaust the available supply of measures of forecast performance. For example, to test for statistical bias in CBO's predictions, previous studies have used measures that are slightly more elaborate than the mean error. Those studies have generally concluded, as does this evaluation, that CBO's short-term economic forecasts do not contain a statistically significant bias.[5]

In addition, a number of methods have been developed to evaluate a forecast's efficiency. Efficiency indicates the extent to which a particular forecast could have been improved by using additional information that was at the forecaster's disposal when the forecast was made.[6] To the extent that the *Blue Chip* consensus forecasts represent a wide variety of economic forecasters--reflecting a broader blend of sources and methods than can be

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5. Another approach to testing a forecast for bias is based on linear regression analysis of actual and forecast values. For details of that method, see J. Mincer and V. Zarnowitz, "The Evaluation of Economic Forecasts," in J. Mincer, ed., *Economic Forecasts and Expectations* (New York: National Bureau of Economic Research, 1969). That approach is not used here because of the small sample size. However, previous studies that have used it to evaluate the short-term forecasts of CBO and the Administration have not been able to reject the hypothesis that those forecasts are unbiased. See, for example, M.T. Belongia, "Are Economic Forecasts by Government Agencies Biased? Accurate?" *Review*, Federal Reserve Bank of St. Louis, vol. 70, no. 6 (November/December 1988), pp. 15-23.

6. For studies that have examined the relative efficiency of CBO's forecasts, see Belongia, "Are Economic Forecasts by Government Agencies Biased?"; and S.M. Miller, "Forecasting Federal Budget Deficits: How Reliable Are U.S. Congressional Budget Office Projections?" *Applied Economics*, vol. 23 (December 1991), pp. 1789-1799. Although both of the studies identify series that might have been used to make CBO's forecasts more accurate, they rely on statistics that assume a larger sample than is available. Moreover, although statistical tests can identify sources of inefficiency in a forecast after the fact, they generally do not indicate how such information can be used to improve forecasts when they are made.

expected in any single forecaster--their use in this evaluation can be interpreted as a proxy for an efficient forecast. The fact that CBO's forecasts are about as accurate as *Blue Chip*'s is a rough indication of forecast efficiency.

More elaborate measures, however, are not necessarily reliable indicators when the sample of observations is small, such as the 17 observations that make up the sample of CBO's two-year forecasts. Small samples present three main types of problems for evaluating forecasts, including forecasts based on the simple measures presented here. First, small samples reduce the reliability of statistical tests that are based on the assumption that the underlying population of forecast errors follows a normal distribution. The more elaborate tests of forecast performance all make such an assumption about the hypothetical ideal forecast with which the actual forecasts are compared. Second, in small samples, individual forecast errors have a relatively large weight in the calculation of summary measures. The mean error, for example, can fluctuate in arithmetic sign when a single observation is added to a small sample. Third, the small sample means that CBO's forecast history cannot be used in a statistically reliable way to indicate either the direction or the size of future forecasting errors.

Apart from the general caution that should attend statistical conclusions based on small samples, there are several other reasons to view this evaluation of CBO's forecasts with particular caution. First, the procedures and purposes of CBO's and the Administration's forecasts have changed over the past 18 years and may change again in the future. For example, in the late 1970s, CBO characterized its long-term projections as a goal for the economy, whereas it now considers its projections to be what will prevail on average if the economy continues to reflect historical trends. Second, an institution's forecasting track record may not foretell its future abilities because of changes in personnel or methods. Finally, forecast errors increase when the economy is more volatile. All three forecasters made exceptionally large errors when forecasting for periods that included turning points in the business cycle.

CBO's Forecasting Record

This analysis evaluated the Congressional Budget Office's forecasts over two-year and four-year periods. The period of most interest for forecasters of the budget is two years. Because the Administration's and CBO's winter budget publications focus on the budget projection for the fiscal year beginning in the following October, an economic forecast that is accurate not only for the months leading up to the budget year but also for the budget year itself will provide the basis for a more accurate forecast of the deficit. A four-year horizon is used to examine the accuracy of longer-term projections of growth in real GNP.

Short-Term Forecasts

Historically, CBO's two-year forecasts are slightly more accurate than the Administration's and suffer from slightly less statistical bias. In most cases, however, the differences are slim. Furthermore, CBO's forecasts are about as accurate as *Blue Chip*'s average forecasts.

An accurate forecast of two-year growth in real output is the most important factor in minimizing errors in forecasting the deficit for the budget year. Accurate forecasts of nominal output, inflation, and nominal interest rates are less important for forecasting deficits now than they were in the late 1970s and early 1980s. The reason is that, given current law and the level of the national debt, inflation increases both revenues and outlays by similar amounts. Revenues increase with inflation because taxes are levied on nominal incomes. Outlays increase because various entitlement programs are indexed to inflation and because nominal interest rates tend to increase with inflation, which in turn increases the cost of servicing the federal debt.[7]

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7.   Rules of thumb for estimating the effect on the deficit of changes in various macroeconomic variables are given in Congressional Budget Office, *The Economic and Budget Outlook: Fiscal Years 1994-1998* (January 1993), pp. 109-113.

Real Output Growth. For the two-year forecasts made between 1976 and 1992, CBO had a slightly better record than the Administration in forecasting real output growth (see Table A-1). On average, both CBO and the Administration tended to overestimate growth of real output. For the 17 forecasts made during the 1976-1992 period, the average errors were 0.4 percentage points for CBO and 0.5 percentage points for the Administration. The root mean square errors for this period were 1.0 percentage point for CBO and 1.3 percentage points for the Administration. CBO was closer to the true value in nine of the 17 periods, the Administration was closer in five periods, and the two forecasters had identical errors in three periods. In addition, CBO's forecasts of two-year growth in real output made in the 1982-1992 period were, on average, about as accurate as the *Blue Chip* consensus.

Forecast errors tend to be larger when the economy is more unstable. This tendency can be clearly seen in the forecasts of real GNP growth by comparing the large errors for 1979 through 1983--when the economy went through its most turbulent recessionary period of the postwar era--with the smaller errors recorded for later years. Similarly, the recent business cycle accounts for the large errors in the forecasts made in 1989 through 1991; during that period, CBO's errors were only slightly larger than those of the *Blue Chip* consensus.

CPI Inflation. The records for forecasting the average annual growth in the consumer price index over the two-year horizon were very similar (see Table A-2). Both CBO and the Administration underestimated future inflation in their forecasts for 1977 through 1980, and both tended to overestimate it in their forecasts for 1981 through 1986. The average measures of bias and accuracy were virtually the same for CBO and the Administration. CBO was closer to the true value in six of the 17 periods, the Administration was closer in eight periods, and the two forecasters had identical errors in three periods. For the 1982-1992 forecasts, CBO's inflation predictions appeared to be about as accurate as those of both the Administration and *Blue Chip*.

Nominal Interest Rates. For the 1976-1992 forecasts, CBO's record was slightly more accurate than the Administration's for nominal short-term interest rates over the two-year horizon (see Table A-3). On average, the Administration tended to underestimate nominal short-term interest rates; CBO's mean error was zero over this period. CBO was closer to the true value in eight of the 17 periods, and the Administration was closer in nine periods. However, for the 1982-1992 period, the mean absolute error of CBO's forecasts was slightly above those of the Administration and *Blue Chip*.

For the 1984-1992 forecasts of long-term interest rates, CBO did significantly better than the Administration (see Table A-4). The Administration tended to underestimate rates, and its mean error was larger than CBO's. In addition, the Administration's forecasts had a larger mean absolute error and root mean square error. CBO was closer to the true value in six of the nine periods, and the Administration was closer in only three periods.

CBO's forecasts of long-term interest rates were about as accurate as those of the *Blue Chip* consensus. Both CBO and *Blue Chip* tended to overestimate long-term rates, each showing a mean error of 0.3 percentage points.

Real Short-Term Interest Rates. For the forecasts made in 1976 through 1992, CBO had a slight edge over the Administration in estimating short-term interest rates adjusted for inflation (see Table A-5). Again, the Administration was more likely than CBO to underestimate interest rates, and its mean error was greater. CBO and the Administration recorded similar mean absolute and root mean square errors. CBO's forecasts were closer to the actual value in 10 of the 17 periods; the Administration's were closer in seven. For forecasts made between 1982 and 1992, CBO's errors were generally similar in both direction and magnitude to those of the *Blue Chip* consensus.

Longer-Term Projections

In forecasting real GNP growth for the more distant future, measured here as four years ahead, the Administration's errors were larger than CBO's. Although this comparative advantage for CBO does not directly affect the estimates of the deficit for the

budget year, accuracy in the longer term is obviously important for budgetary planning over several years. Neither the Administration nor CBO, however, considers its projections to be its best guess about the year-to-year course of the economy. The Administration's projections each year are based on the adoption of the President's budget as submitted, and in recent years CBO has considered its projections an indication of the average future performance of the economy if major historical trends continue. Neither institution attempts to anticipate cyclical fluctuations in the projection period.

CBO's projections of medium-term growth in real GNP for 1976 through 1990 were nearly always closer to actual growth than were the Administration's. The Administration's projections of the average annual rate of real GNP growth over four years showed an upward bias of 1.3 percentage

points, compared with an upward bias of 0.8 percentage points for CBO (see Table A-6). Those biases resulted largely from the inability of the projections made in early 1977 through 1980 to anticipate the recessions of 1980 and 1982. Through the subsequent years of expansion until the most recent recession, the upward bias was much smaller for the Administration's projections and smaller yet for CBO's.

The size of the root mean square errors for the entire period for both CBO and, to a lesser extent, the Administration also results largely from errors in projections made during the first five years. CBO had a definite edge in the projections made in January 1981 and 1982 and a lesser edge in later years. CBO's projections of four-year real GNP growth were more accurate than the Administration's for 14 of the 15 periods compared here.

Table A-1.
Comparison of CBO, Administration, and *Blue Chip* Forecasts of Two-Year
Average Growth Rates for Real Output (By calendar year, errors in percentage points)

	Actual				CBO		Administration		Blue Chip	
	1972 Dollars	1982 Dollars	1987 Dollars	Benchmark-Years-Weighted Index	Forecast	Error	Forecast	Error	Forecast	Error
GNP										
1976-1977	6.7	4.8	4.8	5.5	6.2	0.7	5.9	0.5	a	a
1977-1978	5.2	5.0	4.7	5.2	5.5	0.3	5.1	0	a	a
1978-1979	3.9	3.9	3.8	4.1	4.7	0.6	4.7	0.6	a	a
1979-1980	1.3	1.1	1.1	1.5	2.7	1.2	2.9	1.4	a	a
1980-1981	1.1	0.9	0.5	1.2	0.5	-0.7	0.5	-0.7	a	a
1981-1982	0.2	-0.3	-0.4	0.2	2.1	1.9	2.6	2.4	a	a
1982-1983	0.7	0.5	0.7	0.9	2.1	1.3	2.7	1.8	2.0	1.2
1983-1984	5.2	5.2	4.9	5.1	3.4	-1.7	2.6	-2.5	3.5	-1.6
1984-1985	b	5.1	4.4	4.7	4.7	0	4.7	0	4.3	-0.4
1985-1986	b	3.0	2.8	2.8	3.3	0.5	3.9	1.1	3.2	0.3
1986-1987	b	3.1	2.9	2.9	3.1	0.3	3.7	0.8	3.0	0.1
1987-1988	b	3.9	3.5	3.5	2.9	-0.6	3.3	-0.2	2.8	-0.6
1988-1989	b	3.5	3.3	3.2	2.4	-0.8	3.0	-0.2	2.1	-1.1
1989-1990	b	1.7	2.0	2.0	2.5	0.5	3.2	1.2	2.2	0.2
1990-1991	b	c	0.3	0.2	2.0	1.9	2.8	2.6	1.9	1.8
1991-1992	b	c	0.7	0.7	1.6	1.0	1.4	0.7	1.2	0.5
GDP[d]										
1992-1993	b	c	2.7	2.5	2.6	0.1	2.2	-0.3	2.3	-0.2
Statistics for 1976-1992										
Mean error	n.a.	n.a.	n.a.	n.a.	n.a.	0.4	n.a.	0.5	n.a.	n.a.
Mean absolute error	n.a.	n.a.	n.a.	n.a.	n.a.	0.8	n.a.	1.0	n.a.	n.a.
Root mean square error	n.a.	n.a.	n.a.	n.a.	n.a.	1.0	n.a.	1.3	n.a.	n.a.
Statistics for 1982-1992										
Mean error	n.a.	n.a.	n.a.	n.a.	n.a.	0.2	n.a.	0.5	n.a.	0
Mean absolute error	n.a.	n.a.	n.a.	n.a.	n.a.	0.8	n.a.	1.0	n.a.	0.7
Root mean square error	n.a.	n.a.	n.a.	n.a.	n.a.	1.0	n.a.	1.4	n.a.	0.9

SOURCES: Congressional Budget Office; Office of Management and Budget; Eggert Economic Enterprises, Inc., *Blue Chip Economic Indicators*; Department of Commerce, Bureau of Economic Analysis.

NOTES: Actual values are the two-year growth rates for real gross national product (GNP) and gross domestic product (GDP) last reported by the Bureau of Economic Analysis, not the first reported values. The 1987-dollar series reflects the bureau's revisions published in July 1994. Revised estimates of the benchmark-years-weighted index, however, were not available at the time of publication. Forecast values are for the average annual growth of real GNP or GDP over the two-year period. The forecasts were issued in the first quarter of the initial year of the period or in December of the preceding year. Errors are forecast values minus actual values; thus, a positive error is an overestimate. The benchmark-years-weighted index of actual GNP or GDP was used in calculating the errors.

n.a. = not applicable.

a. Two-year forecasts for the *Blue Chip* consensus were not available until 1982.

b. Data for 1972-dollar GNP and GDP are available only through the third quarter of 1985.

c. Data for 1982-dollar GNP and GDP are available only through the third quarter of 1991.

d. With the 1992 benchmark revision, GDP replaced GNP as the central measure of national output.

Table A-2.
Comparison of CBO, Administration, and *Blue Chip* Forecasts of Two-Year Average
Inflation Rates in the Consumer Price Index (By calendar year, errors in percentage points)

	Actual		CBO		Administration		Blue Chip	
	CPI-U	CPI-W	Forecast	Error	Forecast	Error	Forecast	Error
1976-1977	6.1	6.1	7.1	1.0	6.1	0	a	a
1977-1978	7.0	7.0	4.9	-2.1	5.2	-1.8	a	a
1978-1979	9.4	9.5	5.8	-3.7	6.0	-3.5	a	a
1979-1980	12.4	12.5	8.1	-4.3	7.4	-5.0	a	a
1980-1981	11.9	11.9	10.1	-1.8	10.5	-1.4	a	a
1981-1982	8.2	8.1	10.4	2.1	9.7	1.6	a	a
1982-1983	4.6	4.5	7.2	2.6	6.6	2.1	7.2	2.6
1983-1984	3.8	3.3	4.7	1.0	4.7	1.5	4.9	1.1
1984-1985	3.9	3.5	4.9	1.0	4.5	1.0	5.2	1.3
1985-1986	2.7	2.5	4.1	1.4	4.2	1.7	4.3	1.6
1986-1987	2.8	2.6	3.8	1.2	3.8	1.2	3.8	1.0
1987-1988	3.9	3.8	3.9	0.1	3.3	-0.5	3.6	-0.2
1988-1989	4.4	4.4	4.7	0.3	4.2	-0.2	4.3	-0.1
1989-1990	5.1	5.0	4.9	-0.1	3.7	-1.3	4.7	-0.4
1990-1991	4.8	4.6	4.1	-0.7	3.9	-0.7	4.1	-0.7
1991-1992	3.6	3.5	4.2	0.6	4.6	1.1	4.4	0.8
1992-1993	3.0	2.9	3.4	0.5	3.1	0.2	3.5	0.5
Statistics for 1976-1992								
Mean error	n.a.	n.a.	n.a.	-0.1	n.a.	-0.2	n.a.	n.a.
Mean absolute error	n.a.	n.a.	n.a.	1.4	n.a.	1.5	n.a.	n.a.
Root mean square error	n.a.	n.a.	n.a.	1.8	n.a.	1.9	n.a.	n.a.
Statistics for 1982-1992								
Mean error	n.a.	n.a.	n.a.	0.7	n.a.	0.6	n.a.	0.7
Mean absolute error	n.a.	n.a.	n.a.	0.9	n.a.	1.0	n.a.	0.9
Root mean square error	n.a.	n.a.	n.a.	1.1	n.a.	1.2	n.a.	1.2

SOURCES: Congressional Budget Office; Office of Management and Budget; Eggert Economic Enterprises, Inc., *Blue Chip Economic Indicators*; Department of Labor, Bureau of Labor Statistics.

NOTES: Values are for the average annual growth of the consumer price index (CPI) over the two-year period. Before 1978 the Bureau of Labor Statistics published only one consumer price index series, known today as the CPI-W (the price index of wage earners and clerical workers). In January 1978, however, the bureau began to publish a second, broader consumer price index series, the CPI-U (the price index for all urban consumers). For most years since 1979, CBO forecast the CPI-U; from 1986 through 1989, CBO forecast the CPI-W. The Administration forecast the CPI-W until 1992, when it switched to the CPI-U. *Blue Chip* forecast the CPI-U for the entire period. The forecasts were issued in the first quarter of the initial year of the period or in December of the preceding year. Errors are forecast values minus actual values; thus, a positive error is an overestimate.

n.a. = not applicable.

a. Two-year forecasts for the *Blue Chip* consensus were not available until 1982.

Table A-3.
Comparison of CBO, Administration, and *Blue Chip* Forecasts of Two-Year Average
Interest Rates on Three-Month Treasury Bills (By calendar year, errors in percentage points)

| | Actual | | CBO | | Administration | | *Blue Chip* | |
	New Issue	Secondary Market	Forecast	Error	Forecast	Error	Forecast	Error
1976-1977	5.1	5.1	6.2	1.1	5.5	0.4	a	a
1977-1978	6.2	6.2	6.4	0.2	4.4	-1.8	a	a
1978-1979	8.6	8.6	6.0	-2.6	6.1	-2.5	a	a
1979-1980	10.8	10.7	8.3	-2.4	8.2	-2.6	a	a
1980-1981	12.8	12.7	9.5	-3.2	9.7	-3.1	a	a
1981-1982	12.4	12.3	13.2	0.9	10.0	-2.4	a	a
1982-1983	9.7	9.6	12.6	3.0	11.1	1.4	11.3	1.6
1983-1984	9.1	9.1	7.1	-2.0	7.9	-1.1	7.9	-1.2
1984-1985	8.5	8.5	8.7	0.3	8.1	-0.4	9.1	0.5
1985-1986	6.7	6.7	8.5	1.8	8.0	1.3	8.5	1.8
1986-1987	5.9	5.9	6.7	0.9	6.9	1.0	7.1	1.2
1987-1988	6.2	6.2	5.6	-0.6	5.5	-0.7	5.7	-0.5
1988-1989	7.4	7.4	6.4	-0.9	5.2	-2.1	6.1	-1.2
1989-1990	7.8	7.8	7.5	-0.3	5.9	-1.9	7.5	-0.3
1990-1991	6.5	6.4	7.0	0.6	6.0	-0.4	7.1	0.7
1991-1992	4.4	4.4	6.8	2.4	6.2	1.8	6.4	2.0
1992-1993	3.2	3.2	4.7	1.5	4.5	1.3	4.6	1.4
Statistics for								
1976-1992								
Mean error	n.a.	n.a.	n.a.	0	n.a.	-0.7	n.a.	n.a.
Mean absolute								
error	n.a.	n.a.	n.a.	1.5	n.a.	1.6	n.a.	n.a.
Root mean								
square error	n.a.	n.a.	n.a.	1.7	n.a.	1.7	n.a.	n.a.
Statistics for								
1982-1992								
Mean error	n.a.	n.a.	n.a.	0.6	n.a.	0	n.a.	0.6
Mean absolute								
error	n.a.	n.a.	n.a.	1.3	n.a.	1.2	n.a.	1.1
Root mean								
square error	n.a.	n.a.	n.a.	1.6	n.a.	1.3	n.a.	1.3

SOURCES: Congressional Budget Office; Office of Management and Budget; Eggert Economic Enterprises, Inc., *Blue Chip Economic Indicators*; Federal Reserve Board.

NOTES: Values are for the geometric averages of the three-month Treasury bill rates for the two-year period. The actual values are published by the Federal Reserve Board as the rate on new issues, reported on a bank-discount basis, and the secondary-market rate. CBO forecast the secondary-market rate; the Administration forecast the new-issue rate. The *Blue Chip* alternated between the two rates, forecasting the new-issue rate from 1982 to 1985, the secondary-market rate from 1986 to 1991, and the new-issue rate again beginning in 1992. The forecasts were issued in the first quarter of the initial year of the period or in December of the preceding year. Errors are forecast values minus actual values; thus, a positive error is an overestimate.

n.a. = not applicable.

a.   Two-year forecasts for the *Blue Chip* consensus were not available until 1982.

Table A-4.
Comparison of CBO, Administration, and *Blue Chip* Forecasts of Two-Year Average Long-Term Interest Rates (By calendar year, errors in percentage points)

| | Actual | | CBO | | Administration | | Blue Chip | |
	10-Year Note	Corporate Aaa Bond	Forecast	Error	Forecast	Error	Forecast	Error
1984-1985	11.5	12.0	11.9	-0.1	9.7	-1.8	12.2	0.2
1985-1986	9.1	10.2	11.5	1.3	10.6	1.5	11.8	1.7
1986-1987	8.0	9.2	8.9	0.9	8.7	0.7	9.9	0.8
1987-1988	8.6	9.5	7.2	-1.4	6.6	-2.0	8.7	-0.8
1988-1989	8.7	9.5	9.4	0.7	7.7	-1.0	9.8	0.3
1989-1990	8.5	9.3	9.1	0.6	7.7	-0.8	9.5	0.3
1990-1991	8.2	9.0	7.7	-0.5	7.2	-1.0	8.7	-0.3
1991-1992	7.4	8.5	7.8	0.4	7.3	-0.1	8.7	0.3
1992-1993	6.4	7.7	7.1	0.7	6.9	0.5	8.4	0.7
Statistics for 1984-1992								
Mean error	n.a.	n.a.	n.a.	0.3	n.a.	-0.4	n.a.	0.3
Mean absolute error	n.a.	n.a.	n.a.	0.7	n.a.	1.0	n.a.	0.6
Root mean square error	n.a.	n.a.	n.a.	0.8	n.a.	1.2	n.a.	0.7

SOURCES: Congressional Budget Office; Office of Management and Budget; Eggert Economic Enterprises, Inc., *Blue Chip Economic Indicators*; Federal Reserve Board.

NOTES: Actual values are for the geometric averages of the 10-year Treasury note rates or Moody's corporate Aaa bond rates for the two-year period as reported by the Federal Reserve Board. CBO forecast the 10-year Treasury note rate in all years except 1984 and 1985. The Administration forecast the 10-year note rate, but *Blue Chip* forecast the corporate Aaa bond rate. Data are only available beginning in 1984 since not all of the forecasters published long-term rate projections before then. The forecasts were issued in the first quarter of the initial year of the period or in December of the preceding year. Errors are forecast values minus actual values; thus, a positive error is an overestimate.

n.a. = not applicable.

Table A-5.
Comparison of CBO, Administration, and *Blue Chip* **Forecasts of Two-Year Average Interest Rates on Three-Month Treasury Bills Adjusted for Inflation (By calendar year, errors in percentage points)**

| | Actual | | | | CBO | | Administration | | *Blue Chip* | |
| | New Issue | | Secondary Market | | | | | | | |
	CPI-U	CPI-W	CPI-U	CPI-W	Forecast	Error	Forecast	Error	Forecast	Error
1976-1977	-0.9	-0.9	-0.9	-0.9	-0.8	0.1	-0.6	0.3	a	a
1977-1978	-0.8	-0.7	-0.8	-0.7	1.5	2.2	-0.8	-0.1	a	a
1978-1979	-0.7	-0.8	-0.7	-0.8	0.2	1.0	0.1	0.9	a	a
1979-1980	-1.4	-1.5	-1.4	-1.5	0.2	1.7	0.7	2.2	a	a
1980-1981	0.8	0.9	0.7	0.8	-0.5	-1.2	-0.7	-1.6	a	a
1981-1982	3.8	4.0	3.7	3.9	2.6	-1.2	0.3	-3.7	a	a
1982-1983	4.8	4.9	4.7	4.9	5.0	0.3	4.2	-0.8	3.8	-1.0
1983-1984	5.1	5.7	5.1	5.6	2.2	-2.9	3.1	-2.6	2.9	-2.3
1984-1985	4.4	4.9	4.4	4.8	3.6	-0.8	3.4	-1.4	3.6	-0.8
1985-1986	3.9	4.1	3.9	4.1	4.2	0.3	3.6	-0.4	4.0	0.1
1986-1987	3.0	3.2	3.0	3.2	2.8	-0.4	3.0	-0.3	3.2	0.2
1987-1988	2.3	2.4	2.3	2.3	1.7	-0.6	2.1	-0.2	2.0	-0.3
1988-1989	2.8	2.9	2.8	2.9	1.7	-1.2	1.0	-1.9	1.8	-1.1
1989-1990	2.6	2.6	2.6	2.6	2.5	-0.2	2.1	-0.6	2.7	0.2
1990-1991	1.6	1.7	1.5	1.7	2.8	1.3	2.0	0.3	2.9	1.4
1991-1992	0.8	0.9	0.7	0.9	2.5	1.8	1.5	0.6	1.9	1.2
1992-1993	0.2	0.4	0.2	0.3	1.3	1.0	1.3	1.1	1.1	0.8
Statistics for 1976-1992										
Mean error	n.a.	n.a.	n.a.	n.a.	n.a.	0.1	n.a.	-0.5	n.a.	n.a.
Mean absolute error	n.a.	n.a.	n.a.	n.a.	n.a.	1.1	n.a.	1.1	n.a.	n.a.
Root mean square error	n.a.	n.a.	n.a.	n.a.	n.a.	1.3	n.a.	1.5	n.a.	n.a.
Statistics for 1982-1992										
Mean error	n.a.	n.a.	n.a.	n.a.	n.a.	-0.1	n.a.	-0.6	n.a.	-0.1
Mean absolute error	n.a.	n.a.	n.a.	n.a.	n.a.	1.0	n.a.	0.9	n.a.	0.8
Root mean square error	n.a.	n.a.	n.a.	n.a.	n.a.	1.2	n.a.	1.2	n.a.	1.0

SOURCES: Congressional Budget Office; Office of Management and Budget; Eggert Economic Enterprises, Inc., *Blue Chip Economic Indicators*; Department of Labor, Bureau of Labor Statistics; Federal Reserve Board.

NOTES: Values are for the appropriate three-month Treasury bill rate discounted by the respective forecast for inflation as measured by the change in the consumer price index. The forecasts were issued in the first quarter of the initial year of the period or in December of the preceding year. Errors are forecast values minus actual values; thus, a positive error is an overestimate.

CPI-U = consumer price index for all urban consumers; CPI-W = consumer price index for wage earners and clerical workers; n.a. = not applicable.

a.   Two-year forecasts for the *Blue Chip* consensus were not available until 1982.

Table A-6.
Comparison of CBO and Administration Forecasts of Four-Year Average Growth Rates for Real Output (By calendar year, errors in percentage points)

	Actual				CBO		Administration	
	1972 Dollars	1982 Dollars	1987 Dollars	Benchmark-Years-Weighted Index	Forecast	Error	Forecast	Error
1976-1979	5.3	4.3	4.3	4.8	5.9	1.1	6.1	1.3
1977-1980	3.2	3.0	2.9	3.3	5.4	2.1	5.4	2.1
1978-1981	2.5	2.4	2.1	2.7	4.8	2.1	4.8	2.2
1979-1982	0.7	0.4	0.4	0.9	3.6	2.7	3.7	2.8
1980-1983	0.9	0.7	0.6	1.0	2.1	1.0	2.6	1.5
1981-1984	2.7	2.4	2.2	2.6	2.6	0	3.7	1.0
1982-1985	a	2.7	2.5	2.8	2.8	0.1	3.8	1.0
1983-1986	a	4.1	3.8	4.0	3.6	-0.3	3.3	-0.7
1984-1987	a	4.1	3.6	3.8	4.1	0.3	4.3	0.6
1985-1988	a	3.5	3.2	3.2	3.3	0.2	4.0	0.8
1986-1989	a	3.3	3.1	3.1	3.3	0.2	3.8	0.8
1987-1990	a	2.8	2.7	2.7	3.0	0.3	3.4	0.7
1988-1991	a	b	1.8	1.7	2.5	0.8	3.2	1.5
1989-1992	a	b	1.3	1.3	2.3	1.0	3.2	1.9
1990-1993	a	b	1.4	1.3	2.3	1.0	3.0	1.7
Statistics for 1976-1990								
Mean error	n.a.	n.a.	n.a.	n.a.	n.a.	0.8	n.a.	1.3
Mean absolute error	n.a.	n.a.	n.a.	n.a.	n.a.	0.9	n.a.	1.4
Root mean square error	n.a.	n.a.	n.a.	n.a.	n.a.	1.2	n.a.	1.5

SOURCES: Congressional Budget Office; Office of Management and Budget; Department of Commerce, Bureau of Economic Analysis.

NOTES: Values are for the four-year growth rates for real gross national product (GNP) last reported by the Bureau of Economic Analysis, not the first reported values. The 1987-dollar series reflects the bureau's revisions published in July 1994. Revised estimates of the benchmark-years-weighted index, however, were not available at the time of publication. Forecast values are for the average growth of real GNP over the four-year period. The forecasts were issued in the first quarter of the initial year of the period or in December of the preceding year. Errors are forecast values minus actual values; thus, a positive error is an overestimate. The benchmark-years-weighted index of actual GNP was used in calculating the errors.

n.a. = not applicable.

a. Data for 1972-dollar GNP are available only through the third quarter of 1985.

b. Data for 1982-dollar GNP are available only through the third quarter of 1991.